PHILIPS

A.C. Current Probe and Amplifier

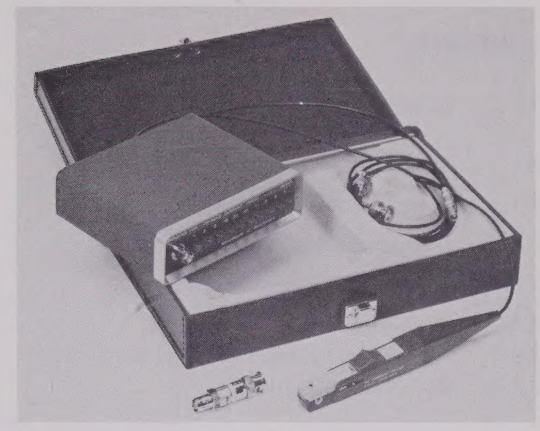
PM 9355

(9499 093 55001)

9499 440 14811 750501/1

PHILIPS

PHILIPS



Instruction manual

A.C. Current Probe and Amplifier

PM 9355

(9499 093 55001)

PHILIPS

9499 440 14811

750501/1

CONTENTS

1.	**Introduction**	5
2.	**Specification**	6
2.1.	Electrical characteristics	6
2.2.	Mechanical characteristics	7
2.3.	Environmental characteristics	7
2.4.	Accessories	7
2.4.1.	Accessories supplied with the instrument	7
2.4.2.	Optional accessories	7
3.	**Directions for use**	8
3.1.	General	8
3.2.	Installation	8
3.3.	Operation	9
3.3.1.	Direction of current flow	9
3.3.2.	Loading of the circuit under test	9
3.3.3.	Probe slider	9
3.3.4.	Earth lead	9
3.3.5.	High currents	9
3.3.6.	Using the clip-on transformer only	10
3.3.7.	Using the clip-on current transformer together with the amplifier	10
3.3.8.	Insertion impedance	10
3.3.9.	Measuring hints	11
4.	**Service data**	12
4.1.	Circuit description	12
4.1.1.	Clip-on current transformer	12
4.1.2.	Amplifier	12
4.2.	Dismantling	14
4.2.1.	Dismantling the clip-on current transformer	14
4.2.2.	Dismantling the amplifier	14
4.3.	Checking and adjusting	15
4.3.1.	Adjusting the clip-on current transformer	15
4.3.2.	Checking and adjusting the probe and amplifier combination	15
4.3.2.1.	Deflection coefficients	15
4.3.2.2.	L.F. Adjustment	16
4.3.2.3.	H.F. Adjustment	16
4.3.2.4.	Noise	16
4.4.	Parts lists and diagrams	17
4.4.1.	Mechanical parts	17
4.4.2.	Electrical parts	19

© N.V. PHILIPS' GLOEILAMPENFABRIEKEN - EINDHOVEN - THE NETHERLANDS - 1975

PRINTED IN THE NETHERLANDS

FIGURES

1.1.	A.C. Current probe and amplifier	5
2.1.	Derating of maximum current for l.f. signals	7
2.2.	Capacitive cross-talk	7
3.1.	Fitting the amplifier to the oscilloscope	8
3.2.	Clip-on current transformer	9
3.3.	Amplifier	10
3.4.	Equivalent circuit forming the insertion impedance	10
4.1.	Dismantling the clip-on current transformer	14
4.2.	Dismantling the amplifier	14
4.3.	Replacing a push-button unit	14
4.4.	L.F. Adjustment	16
4.5.	Clip-on current transformer with item number indication	17
4.6.	Amplifier with item number indication	18
4.7.	Circuit diagram	21
4.8.	Printed-wiring boards of clip-on current transformer and amplifier with indication of adjusting elements	21

NOTE:

The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.

1. Introduction

The type PM 9355 current probe is an alternating-current measuring device consisting of a clip-on current transformer and a frequency-compensated amplifier. The latter incorporates the measuring range switches.

The current probe is intended for use with oscilloscopes having a 50-Ohm-input impedance. Oscilloscopes with a 1-MOhm-impedance may also be used, but only in combination with the supplied 50-Ohm-feedthrough termination.

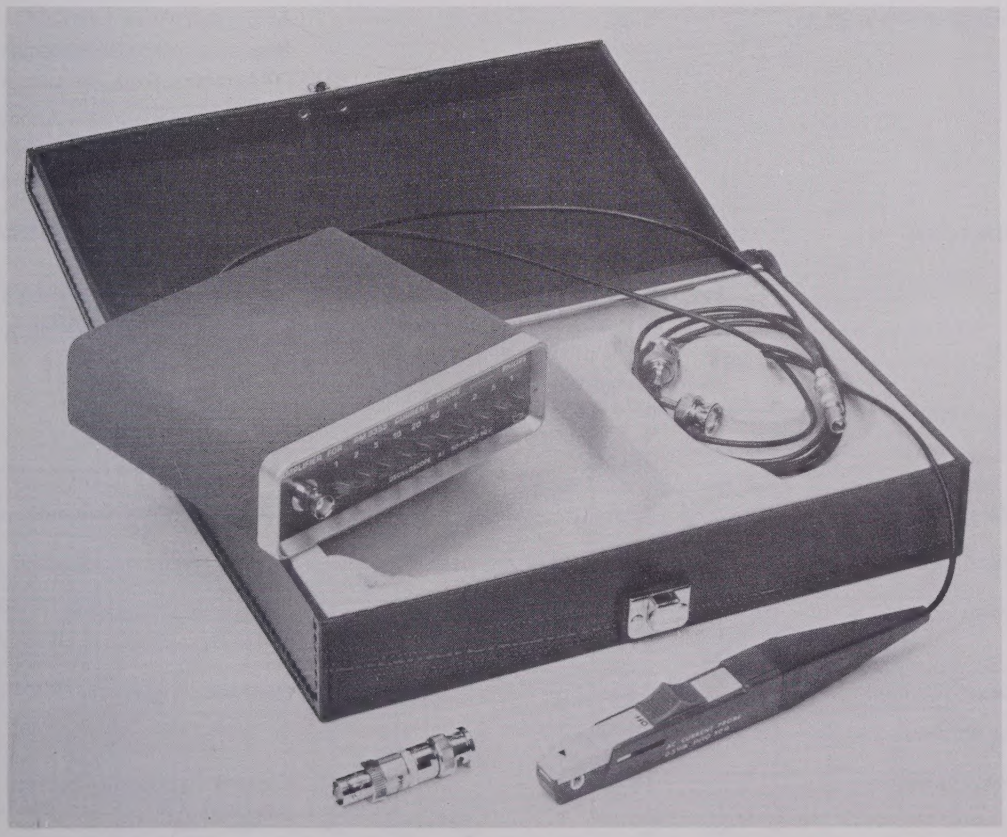


Fig. 1.1. A.C. Current probe and amplifier

2. Specification

Unless otherwise stated, the specifications listed are valid for the type PM 9355 current probe (clip-on current transformer with amplifier) only, i.e. excluding the effects of the test oscilloscope.

Properties expressed in numerical values with tolerances stated, are guaranteed by the manufacturer. Numerical values without tolerances are typical and represent the characteristics of an average current probe.

2.1. ELECTRICAL CHARACTERISTICS

	Characteristics	*Specified performance*	*Additional info*
2.1.1.	Output load	50 Ohm	Oscilloscope to 50 mV/DIV and d.c. input coupling
	Output range	+ or −6 DIV	
	Output offset	+ or −¼ DIV	Oscilloscope to 50 mV/DIV and d.c. input coupling
	Offset drift	negligible	Oscilloscope to 50 mV/DIV and d.c. input coupling
2.1.2.	Deflection coefficient	1 mA/DIV...1 A/DIV in ten ranges (1-2-5 sequence)	Oscilloscope to 50 mV/DIV and d.c. input coupling
2.1.3.	Error limit	+ or −3 %	
2.1.4.	Bandwidth	⩽ 12 Hz to ⩾ 70 MHz (−3 dB) ⩽ 12 Hz to ⩾ 45 MHz (−3 dB)	At 5 mA/DIV to 1 A/DIV At 1 mA/DIV and 2 mA/DIV
2.1.5.	Rise time (10 %-90 %)	5 ns	At 5 mA/DIV to 1 A/DIV Measured at a trace height of + or −4 DIV starting from the centre of the screen
		8 ns	At 1 mA/DIV and 2 mA/DIV Measured at a trace height of + or −4 DIV starting from the centre of the screen
2.1.6.	Aberrations	⩽ + or −5 % during the first 50 ns of step; ⩽ + or −1 % thereafter.	At 1 mA/DIV to 20 mA/DIV
		⩽ + or −6 % during the first 50 ns of step; ⩽ + or −1 % thereafter.	At 50 mA/DIV to 1 A/DIV
2.1.7.	Tilt	⩽ 3 % during the first 400 μs of step	
2.1.8.	Maximum current	12 $A_{p\text{-}p}$	f ⩾ 300 Hz; for l.f. signals see Fig. 2.1.
2.1.9.	Maximum voltage	600 V (d.c. + a.c. peak)	When probe is closed
2.1.10.	Noise	⩽ 150 μA referred to input, or 0,02 DIV whichever is larger	Tangentially measured
2.1.11.	Capacitive load	0,5 to 2 pF	Depends on diameter of conductor
	Capacitive cross-talk	See Fig. 2.2.	
2.1.12.	Delay time	12 ns ±1 ns	Current transformer without amplifier
		25 ns ±2 ns	Current transformer together with amplifier
2.1.13.	Power supply	+24 V at 60 mA −24 V at 60 mA	To be supplied by test oscilloscope or auxiliary power supply PM 9346

2.2. MECHANICAL CHARACTERISTICS

Characteristics	*Specified quantity*				*Additional info*
Dimensions	L	W	H		
Probe body	173	18	28	mm	Maximum dimensions
Probe cable	1500			mm	
Amplifier	130	140	40	mm	Maximum dimensions
Amplifier cables	500			mm	
Case	190	275	50	mm	Maximum dimensions

2.3. ENVIRONMENTAL CHARACTERISTICS

	Characteristics	*Specified performance*	*Additional info*
2.3.1.	Ambient temperature	+5 °C ... +40 °C	Rated range of use
		−10 °C ... +55 °C	Limit range of operation
		−40 °C ... +70 °C	Storage and transport
2.3.2.	Humidity	In accordance with IEC68Db	Non-operating
2.3.3.	Altitude	to 5000 m	Operating within specs
		to 15000 m	Storage
2.3.4.	Vibration	In accordance with IEC68Fc	Operating
2.3.5.	Shock	In accordance with IEC68Eb	Non-operating

For an explanation of the IEC test procedures, refer to PHILIPS DATA SHEET No. 17.7200.32.0556.11.

2.4. ACCESSORIES

2.4.1. Accessories supplied with the instrument

A 50-Ohm-feedthrough termination pad PM 9385.
A hanger assembly.
An instruction manual.
An earth cable.

2.4.2. Optional accessories

Auxiliary probe-power supply PM 9346

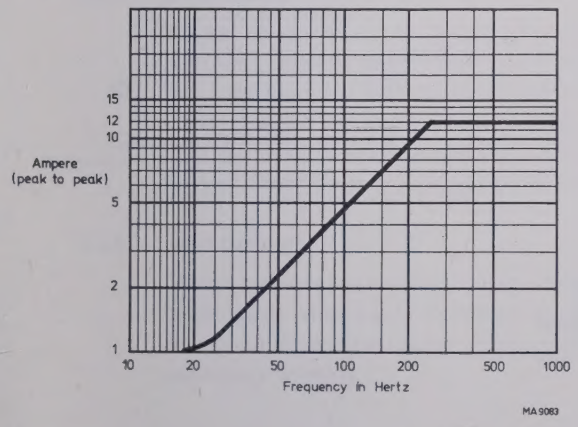


Fig. 2.1. Derating of max. current for l.f. signals

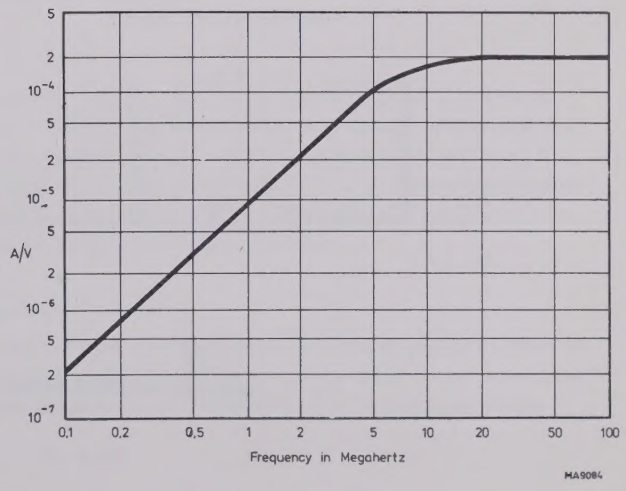


Fig. 2.2. Capacitive cross-talk

3. Directions for use

3.1. GENERAL

Make sure that the oscilloscope you intend to use with the current probe has a 50-Ohm-input impedance. For oscilloscopes with a high input impedance, insert the supplied 50-Ohm-feedthrough termination pad into the lead from the current probe amplifier to the oscilloscope. USE THE TERMINATION PAD ONLY FOR THE PROBE IT IS SUPPLIED WITH, SINCE THE AMPLIFIER HAS BEEN CALIBRATED WITH THIS PAD.
If the oscilloscope to be used has not been fitted with a + and −24-V-power outlet for active probes, auxiliary probe power supply PM 9346 may be used.

3.2. INSTALLATION

Connect the cable of the clip-on current transformer to the BNC input socket at the front of the current probe amplifier. Connect the output cable of the amplifier to the vertical input of the oscilloscope; if necessary, use the 50-Ohm-feedthrough termination pad.
Connect the supply lead of the amplifier to the ±24-V-probe power outlet of the oscilloscope; if necessary, use auxiliary probe power supply PM 9346.

If you want to make a more permanent measuring set-up, the amplifier case may be fastened to the oscilloscope cabinet by means of the hanger assembly which is supplied with the probe.

The mounting procedure is as follows:

1. Remove the amplifier cabinet in accordance with section 4.2.2.
2. Drill at either side of the cabinet a 3,5 mm dia hole, at a distance of 19,5 mm from the bottom and at 54 mm from the front of the cabinet (refer to Fig. 3.1.1.).
3. Refit the cabinet and check that there is a 3 mm threaded hole accessible through either newly drilled hole.
4. Place the amplifier at a convenient place on top of the oscilloscope. For convenience of operation, the front panel controls should extend beyond the oscilloscope front.
5. Mark the place of the amplifier and drill two 8 mm dia holes, separated by 152 mm, in the top plate of the oscilloscope. These holes must be drilled at such a place that they are vertically in line with the holes at either side of the amplifier (Fig. 3.1.2.).
6. Place the amplifier between the holes.
7. Hook the thin end of the supplied brackets in the 8 mm dia holes (position of brackets as shown in Fig. 3.1.3.) and screw the brackets to either side of the amplifier by means of the supplied screws and washers. The supplied screws are metric 3 mm and fit the 3 mm dia threaded holes accessible through the newly drilled 3,5 mm dia holes.

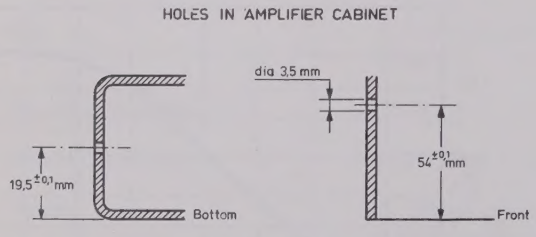


Fig. 3.1.1.

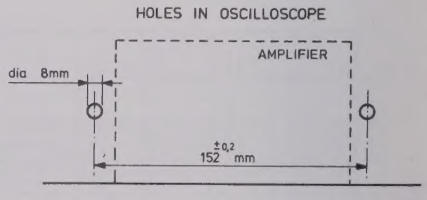


Fig. 3.1.2.

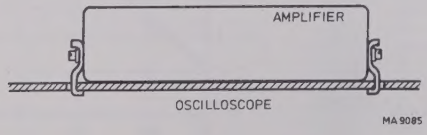


Fig. 3.1.3.

Fig. 3.1. Fitting the amplifier to the oscilloscope

3.3. OPERATION

3.3.1. Direction of current flow

Conventional current (flowing from + to —) flowing in the direction of the arrow on the probe will cause an upward deflection on the c.r.t. screen. This applies only, of course, if the signal polarity has not been inverted by means of the NORM/INVERT control of the oscilloscope.

3.3.2. Loading of the circuit under test

Whenever possible, clamp the clip-on current transformer around the low-potential or earth end of a component lead. In this way, loading of critical circuits and display of noise and interference will be minimized.

3.3.3. Probe slider

The probe slider is used to open the clip-on transformer core in the probe tip and to close it around the conductor under test. This conductor then acts as the primary of the current transformer.

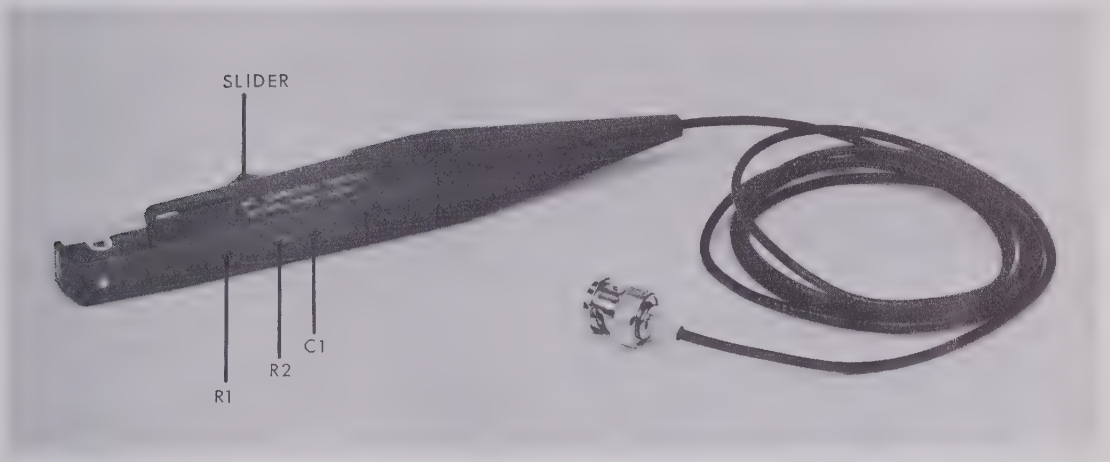


Fig. 3.2. Clip-on current transformer

Make sure that during the measurements the slider is pushed all the way foreward, the word ON visible, as this guarantees the maximum contact between the movable and stationary part of the transformer core. If the slider has not been pushed all the way foreward, large l.f. errors may occur.

As an extra protection to the circuit under test, the screening around the transformer core is only connected to earth when the slider is in the foremost (ON) position. In this way, accidental short circuits to earth are prevented when the probe is clamped around the conductor under test.

3.3.4. Interference

Do not clamp the current transformer around a conductor which is part of a current loop with a large area. This loop picks up interference which will be displayed together with the signal. If it is inevitable to measure in a large loop, the order of magnitude of the interference may be obtained by leaving the probe around the conductor and switching off the test current. The signal which is then displayed, is the picked-up interference. It is also possible to determine the interference by a differential measurement. Clamp to this end the clip-on current transformer around both the forward and return conductor at the same time.

3.3.5. High currents

If high currents are measured, never disconnect the clip-on current transformer from the amplifier or from its termination when it is still clamped around the conductor under test. When the probe cable is not terminated in this condition, a very high voltage which is likely to damage the current transformer is produced in the secundary winding.

3.3.6. Using the clip-on current transformer only

The clip-on current transformer may be used without the amplifier on an oscilloscope with a 50-Ohm-input impedance or via the 50-Ohm-feedthrough termination pad. Bear in mind, however, that the transformation ratio is 1:99 instead of 1:100 for the probe only. When the amplifier is used, this ratio is made up to 1:100 in the amplifier. This means that for the probe only, the output signal is not 0,5 V/A but 0,505 V/A. The overall deflection coefficient may be found in this case by multiplying $\frac{99}{50}$ A/V by the deflection coefficient the oscilloscope is set to.

Example: Oscilloscope setting 1 mV/DIV; the overall deflection coefficient is then: $\frac{99A}{50V} \cdot \frac{1\ mV}{DIV} = 1{,}98\ mA/DIV.$

If desired, the oscilloscope's gain may be changed to make up a ratio of 1:100. Clamp to this end the probe around the CAL current loop of the oscilloscope and readjust the overall gain of the oscilloscope to obtain the required trace height. .

3.3.7. Using the clip-on current transformer together with the amplifier

In this case, the entire deflection coefficient is indicated on the push-button labels at the front of the amplifier. Bear in mind that these coefficients are only valid when the test oscilloscope has been set to a deflection coefficient of 50 mV/DIV.

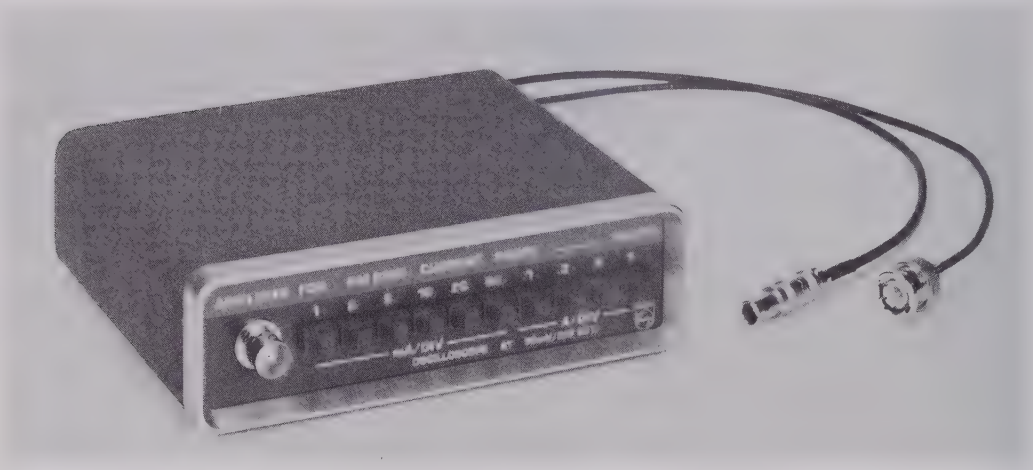


Fig. 3.3. Amplifier

3.3.8. Insertion impedance

The insertion impedance of the current probe is the equivalent circuit that is inserted into the current path when the clip-on current transformer is clamped around the conductor under test. The equivalent circuit is shown in Fig. 3.4. In the flat part of the frequency characteristic, the insertion impedance is approximately

$\frac{50\ Ohm}{99^2\ turns} \approx 5\ mOhm.$

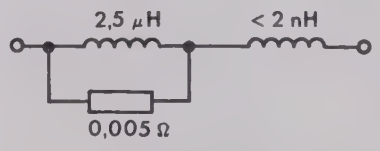


Fig. 3.4. Equivalent circuit forming the insertion impedance

3.3.9. Measuring hints

3.3.9.1. Increasing the sensitivity

The current sensitivity may be increased by increasing the number of primary turns. Looping the conductor under test through the current transformer twice results in an increase of the secundary current by a factor of two, since the current ratio in a transformer is inversely proportional to the turns ratio.
However, bear in mind that the insertion impedance which comes in series with the circuit being measured varies as the square of the primary turns.

The sensitivity may also be increased by setting the oscilloscope's deflection coefficient to a lower value. If the coefficient is set to 10 mV/DIV, the sensitivity for currents is increased by a factor of five. A disadvantage, however, is the display of more noise.

3.3.9.2. Decreasing the sensitivity

In order to measure higher currents than the specified maximum current of 12 $A_{p\text{-}p}$, the current sensitivity of the probe may be decreased as follows. Interrupt the conductor the high current of which must be measured. Take two, three or more pieces of identical wire, cut them to approximately 10 cm and solder the wires together at both ends, in such a fashion that a conductor of two, three or more wires in parallel is obtained. Close the current path by bridging the interruption of the current path by means of the wire assembly. Clamp the clip-on current transformer around ONE of the wires of the assembly. If the assembly consists of two wires, the current through the probe will be half of the current through the conductor, one third of the current if the assembly consists of three wires, and so on.

4. Service data

4.1. CIRCUIT DESCRIPTION (Fig. 4.7.)

4.1.1. Clip-on current transformer

The current to be measured is inductively picked up by the primary of transformer T101. The current is transformed down by a factor of 99. The correction networks R1/L127, R2/L126 and C1/R126 allow setting of optimum pulse response and rise time. Network R127/L128 and transformer L129 compensate for losses in the cable between current transformer and amplifier.

4.1.2. Amplifier

The signal on output socket BU2 of the clip-on current transformer, is applied to input socket BU1 of the amplifier. Networks R201/C201 and R272/C200 in the input stage act as a termination for the cable between the current transformer and the amplifier, whereas networks R271/L202 and R273/L203 compensate for losses in this cable.

To achieve the different measuring ranges in 1-2-5 sequence, an input attenuator has been used in combination with different outputs of emitter follower TS203 and gain-setting networks in the output stage. Reed relays switch in the various combinations as dictated by the push-button switches on the front panel.

The input attenuator comprises two low-ohmic voltage divider sections which are bypassed in certain measuring ranges. The section with resistor R204 gives an attenuation of 10 times and the one with R206 of 100 times. Trimmer capacitor C215 and potentiometer R210 make the sections independent of frequency and potentiometer R200 allows adjustment of the 50 mA/DIV range and onwards.

From the input attenuator, the signal is fed to the first amplifier stage which consists of transistors TS201 and TS202. This stage may be considered as an operational amplifier with a gain of approximately 3 times. This gain is determined by the ratio between feedback resistor R209 and resistor R273 in the input attenuator when the latter is in the "straight-through" position.

The input resistance of the operational amplifier is low: the input is a virtual earth point. This is true because the input resistance is formed by the feedback resistance of R209 divided by the open-loop gain of transistor TS201. As this gain is very high, the input resistance is only a few ohms. The input resistance must be equal in all positions of the input attenuator. In the 10x and 100x attenuated positions, the input resistance equals R200//R203//R205 = 5 Ohm. The input resistance in the "straight-through" position equals the input resistance of transistor TS201. This resistance is adjusted to 5 Ohm by varying the open-loop gain of transistor TS201 with the aid of preset potentiometer R274.

The three times amplified signal on the emitter of TS202 is further amplified by this transistor. The signal at its collector is 20x the signal at the attenuator input.

The −3 dB turn-over frequency of the clip-on current transformer at the lower side of the frequency-response curve is determined by the self-inductance and the internal resistance of the current transformer, and by the input resistance of the amplifier. This frequency is approximately 120 Hz. The specified lower frequency limit of the current transformer/amplifier combination, however, is 12 Hz. In order to obtain this lower frequency limit, the gain of transistor TS202 is increased for frequencies below 120 Hz. The gain increase is proportional to the roll-off below 120 Hz of the clip-on current transformer's frequency response curve.

The gain increase is obtained by splitting the collector load of transistor TS202 into a higher frequency part and a low frequency part. At higher frequencies, the collector load is formed by resistor R217, the other resistor R216 being bypassed by capacitor C208 and the transformed C211. At low frequencies, the load is chiefly determined by resistor R216, increasing the gain up to approximately 200 at 12 Hz. In this way, a frequency response for the combination with a lower −3 dB point of 12 Hz is realized.

For a flat frequency response curve it is, of course, essential that the turn-over frequency of the clip-on current transformer and the frequency at which the gain of transistor TS202 starts increasing are the same. These frequencies are equalized by varying the value of the bypass capacitor in parallel with resistor R216.

The value of the bypass capacitor is varied with the aid of operational amplifier IC201. The gain of this amplifier is determined by resistors R236 and R233: gain $A = \frac{R236}{R233}$. This means that the voltage across C211 is (A+1) times the voltage at junction R216-R217. Potentiometer R236 allows this voltage to be varied by a factor of 10. As $Q = C.V$ (in which Q is the charge of a capacitor, C its capacitance and V the voltage across the capacitor), or $C = \frac{Q}{V}$, we have a method to vary the capacitance of C211. The charge Q is constant and by varying the voltage V by a factor of 10, the capacitance C will be virtually varied by a factor of 10. The result is that capacitor C211 may be varied between 1 μF and 100 nF. As C211 is in parallel with resistor R216, potentiometer R236 allows the turn-over frequency of the amplifier to be aligned with the turn-over frequency of the clip-on current transformer.

The signal on the collector of transistor TS202 is applied to emitter-follower TS203. The emitter signal of TS203 is available at three different levels. These levels are selected together with the input attenuator sections with the aid of the reed relays operated by the push-buttons SK1A ... J.

The d.c. level at the emitter of transistor TS203 is compared to earth level (point 4) in IC201. The difference is fed back to the emitter of TS203, via transistors TS205 and TS202. The phase of the feedback signal is such that any d.c. level on the emitter of TS203 is compensated for: the emitter potential is maintained at 0 V. For a.c. signals, the feedback system is short-circuited by capacitor C213.

Via emitter-follower TS204, the emitter signal of transistor TS203 is applied to the amplifier stage with transistor TS206. The gain of this stage is 5x in positions 1 and 2 mA/DIV and 1x in the other positions. This difference in gain is accomplished by varying the emitter resistance of transistor TS206 with the aid of relay RE209. The x1 gain is adjusted by means of preset potentiometer R246 and the x5 gain by R248. The other networks in the emitter of TS206 enable the square-wave response to be optimized. Transistor TS207 acts as a voltage source for the amplifier stage. Transistor TS208 is the output stage with a gain of unity when the output terminates in 50 Ohm. IC201 and TS209 are part of a feedback system similar to the one with IC201 and TS205. With the aid of this feedback system the d.c. output level is maintained at 0 V.

4.2. DISMANTLING

4.2.1. Dismantling the clip-on transformer (Fig. 4.1.)

- Withdraw the strain relief boot A.
- Remove screw B; mind the nut
- Slightly lift tail piece C and pull it out of the slider, together with the spring D.
- Pull the slider back until its securing notch at the nose of the clip-on transformer is free.
- With the aid of a knife, bend both sides of the clip-on transformer casing at points E and lift the notches at the side of the slider out of the guiding slots.
- Take the slider out of the casing; mind the movable part of the transformer core which is loose in the slider.
- Remove screw F which secures the printed-wiring board.
- Lever the stationary part of the transformer core together with the printed-wiring board out of the casing; the stationary part of the transformer core plugs into the socket on the printed-wiring board.

To reassemble the clip-on current transformer, proceed in reverse order. Before the clip-on current transformer is reassembled, the contact areas of the transformer cores must be cleaned with a soft cloth and plain water or alcohol and not be touched again. We recommend to clean the contact areas at regular intervals.

4.2.2. Dismantling the amplifier (Fig. 4.2.)

- Remove the two screws on the rear panel of the cabinet.
- Slide the cabinet off the amplifier; all components on the printed-wiring board are then easily accessible. To replace a single push-button unit, bend tags (refer to Fig. 4.3.) and unsolder the connecting pins.

Replacing the printed-circuit board:

- Unsolder or unscrew both earth connections A.
- Unsolder the connections to socket and cables.
- Remove the two recessed-head screws that secure the push-button set to the front panel.
- Remove both screws B.

The printed-wiring board can then be removed.

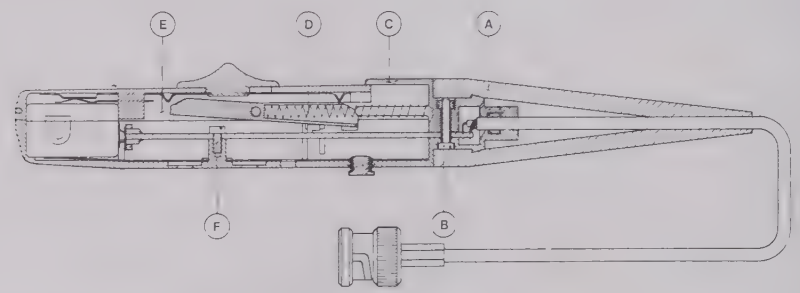


Fig. 4.1. Dismantling the clip-on current transformer

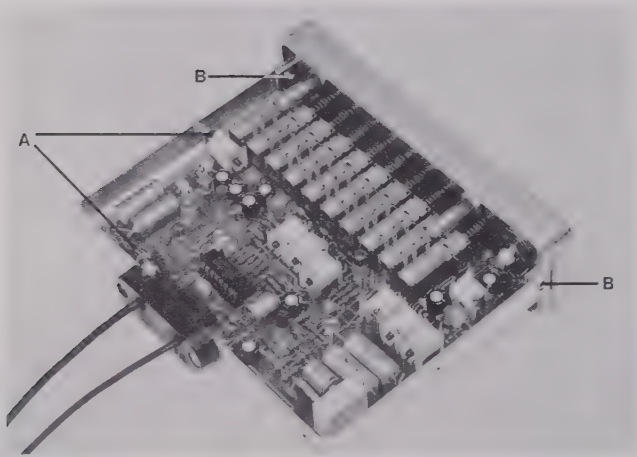


Fig. 4.2. Dismantling the amplifier

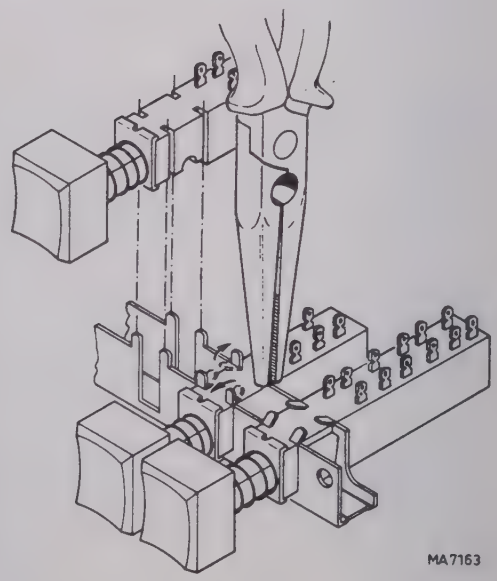


Fig. 4.3. Replacing a push-button unit

4.3. CHECKING AND ADJUSTING

The current probe is adjusted in the following sequence:
1. The clip-on current transformer only.
2. The combination clip-on current transformer and amplifier.

Note: Always use the current probe with the same 50-Ohm-feedthrough termination pad.

4.3.1. Adjusting the clip-on current transformer

In the interest of brevity, we shall use the term PROBE instead of clip-on current transformer throughout the entire checking and adjusting procedure.

- Connect the probe via the 50-Ohm pad to the Y input of a 100-MHz-oscilloscope.
- Clamp the probe around a conductor carrying a square-wave current of 200 mA_{p-p} (10 V_{p-p} across 50 Ohm), rise time 1 ns.
- Set the Y deflection coefficient of the oscilloscope to 20 mV/DIV.
- Check that the trace height is 5 DIV.
- Adjust trimmer potentiometers R1 and R2 and trimmer capacitor C1 (Fig. 3.2.) for optimum square-wave response. The own rise time of the probe must be $\leqslant$ 1 ns.
- Clamp the probe around a conductor carrying a sine-wave current of 200 mA_{p-p} (10 V_{p-p} across 50 Ohm), frequency 100 kHz; the trace height is 5 DIV.
- Lower the frequency of the input current until the trace height is 3,5 DIV.
- Check that the frequency of the input current is $\leqslant$ 450 Hz.

4.3.2. Checking and adjusting the probe and amplifier combination (Fig. 4.8.)

Unless otherwise stated, the controls always occupy the same position as in the previous check.

4.3.2.1. Deflection coefficients

- Connect the probe to the amplifier input.
- Connect the amplifier output via the 50-Ohm-pad to the Y input of a 100-MHz-oscilloscope and the amplifier power cable to a + and −24-V-power source; no push-buttons depressed.
- Set the Y deflection coefficient of the oscilloscope to 50 mV/DIV.
- Set the input coupling switch of the oscilloscope to 0.
- Set the oscilloscope to automatic triggering.
- Centre the time-base line by means of the POSITION potentiometers.
- Set the input coupling switch of the oscilloscope to DC.
- Depress the 5 mA/DIV push-button on the amplifier.
- Check that the time-base line is still in the centre of the oscilloscope screen; tolerance + or −¼ DIV.
- Apply a symmetrical square-wave current of 30 mA_{p-p}, frequency 10 kHz, mark-space ratio 50 %, to the probe.
- Check that the trace height is 6 DIV; if necessary, readjust preset potentiometer R246.
- Check the deflection coefficients 10 mA/DIV and 20 mA/DIV using suitable current values; tolerance + or −3 %.
- Depress the 50 mA/DIV push-button on the amplifier.
- Increase the input current to 300 mA_{p-p}.
- Check that the trace height is 6 DIV; if necessary, readjust preset potentiometer R200.
- Depress the 1 mA/DIV push-button on the amplifier.
- Decrease the input current to 6 mA_{p-p}.
- Check that the trace height is 6 DIV; if necessary, readjust preset potentiometer R248.
- Depress the 0,5 A/DIV push-button on the amplifier.
- Increase the input current to 300 mA_{p-p}.
- Set the Y deflection coefficient of the oscilloscope to 5 mV/DIV.
- Check that the trace height is 6 DIV + or −3 %.

4.3.2.2. L.F. Adjustment

- Set the Y deflection coefficient of the oscilloscope to 50 mV/DIV.
- Depress the 50 mA/DIV push-button on the amplifier.
- Apply a square-wave current of 300 $mA_{p\text{-}p}$, frequency 100 Hz, to the probe.
- Check that the top of the displayed pulse is straight; if necessary, readjust preset potentiometer R236 (Fig. 4.4.).
- Decrease the input current to 30 $mA_{p\text{-}p}$.
- Depress the 5 mA/DIV push-button on the amplifier.
- Check that the top of the displayed pulse is straight; if necessary, readjust preset potentiometer R274 (Fig. 4.4.).
- Apply a sine-wave current of 30 $mA_{p\text{-}p}$, frequency 1 kHz, to the probe. The trace height is 6 DIV.
- Lower the frequency of the input current until the trace height is 4,2 DIV.
- Check that the frequency of the input current is $\leqslant$ 12 Hz.

4.3.2.3. H.F. Adjustment

- Depress the 5 mA/DIV push-button on the amplifier.
- Apply a square-wave current of 20 $mA_{p\text{-}p}$, rise time 1 ns, to the probe.
- Check the pulse response; if necessary, readjust preset potentiometers R220 and R247 and trimmer capacitor C218.
- Check that the rise time of the amplifier/probe combination is $\leqslant$ 5 ns (use the correction formula $t_{r\ probe} = \sqrt{(t^2_{r\ screen} - t^2_{r\ scope})}$.
- Depress the 50 mA/DIV push-button on the amplifier.
- Increase the value of the input current to 200 $mA_{p\text{-}p}$.
- Check the pulse response; if necessary, readjust trimmer capacitor C215 for optimum square-wave response.
- Depress the 0.5 A/DIV push-button on the amplifier.
- Set the Y deflection coefficient of the oscilloscope to 5 mV/DIV.
- Check the pulse response; if necessary, readjust preset potentiometer R210 for optimum square-wave response.
- Apply a square-wave current of 4 $mA_{p\text{-}p}$, rise time 1 ns, to the probe.
- Depress the 1 mA/DIV push-button on the amplifier.
- Set the Y deflection coefficient of the oscilloscope to 50 mV/DIV.
- Check the square-wave response; if necessary, readjust preset potentiometer R249 and trimmer capacitor C219.
- Check that the rise time of the amplifier/probe combination is $\leqslant$ 8 ns (use correction formula).

4.3.2.4. Noise

- Push the slider on the probe all the way foreward.
- Check that the noise does not exceed 150 μA, tangentially measured.

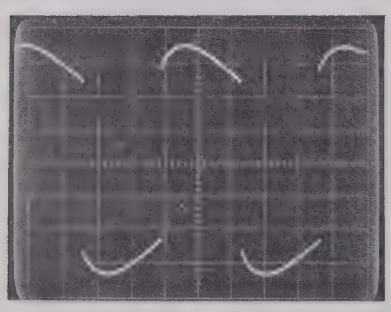


Fig. 4.4.1. Under-compensated

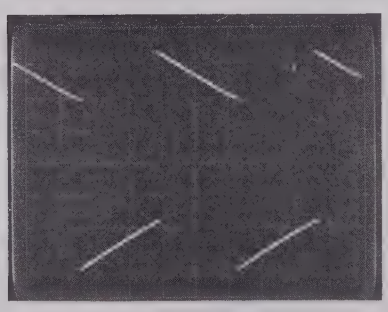


Fig. 4.4.2. Correctly adjusted

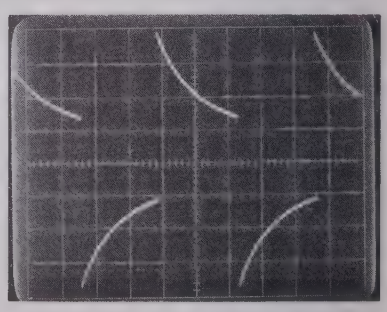


Fig. 4.4.3. Over-compensated

Fig. 4.4. L.F. Adjustment

4.4. PARTS LISTS AND DIAGRAMS

(Subject to alteration without notice)

4.4.1. Mechanical parts

Item	*Fig.*	*Qty per unit*	*Order number*	*Description*
1	4.5.	1	5322 447 64014	Cover with slider
2	4.5.	1	5322 142 74006	Moving part of core
3	4.5.	1	5322 142 74005	Stationary part of core
4	4.5.	1	5322 216 94107	Printed-wiring board in probe
5	4.5.	1	5322 447 64013	Housing complete
6	4.5.	1	5322 320 14025	Cable with strain relief boot

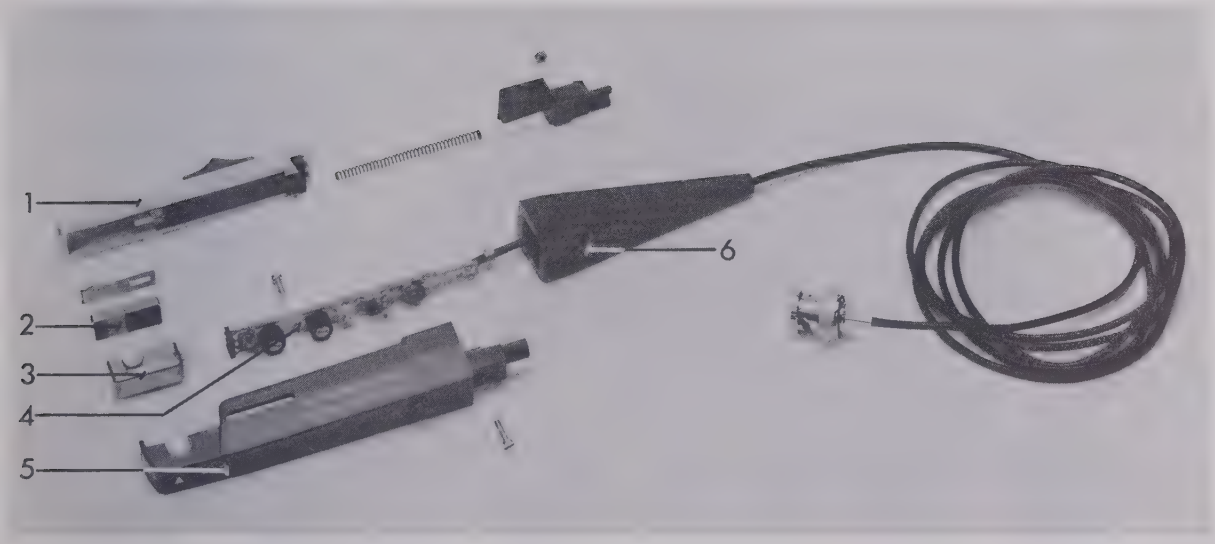


Fig. 4.5. Clip-on current transformer with item number indication

Item	Fig.	Qty. per unit	Order number	Description
7	4.6.	10	5322 276 84041	Single push-button switch
8	4.6.	8	5322 281 64149	Reed relay coil 6 V
9	4.6.	8	5322 280 24036	Reed relay contact
10	4.6.	1	5322 216 94135	Printed-wiring board in amplifier
11	4.6.	1	5322 447 94166	Amplifier cabinet
12	4.6.	1	5322 459 24046	Ornamental frame
13	4.6.	1	5322 456 94047	Text plate
14	4.6.	1	5322 267 10004	B.N.C.
15	4.6.	1	5322 321 24249	Supply cable complete
16	4.6.	1	5322 320 14026	Output cable complete

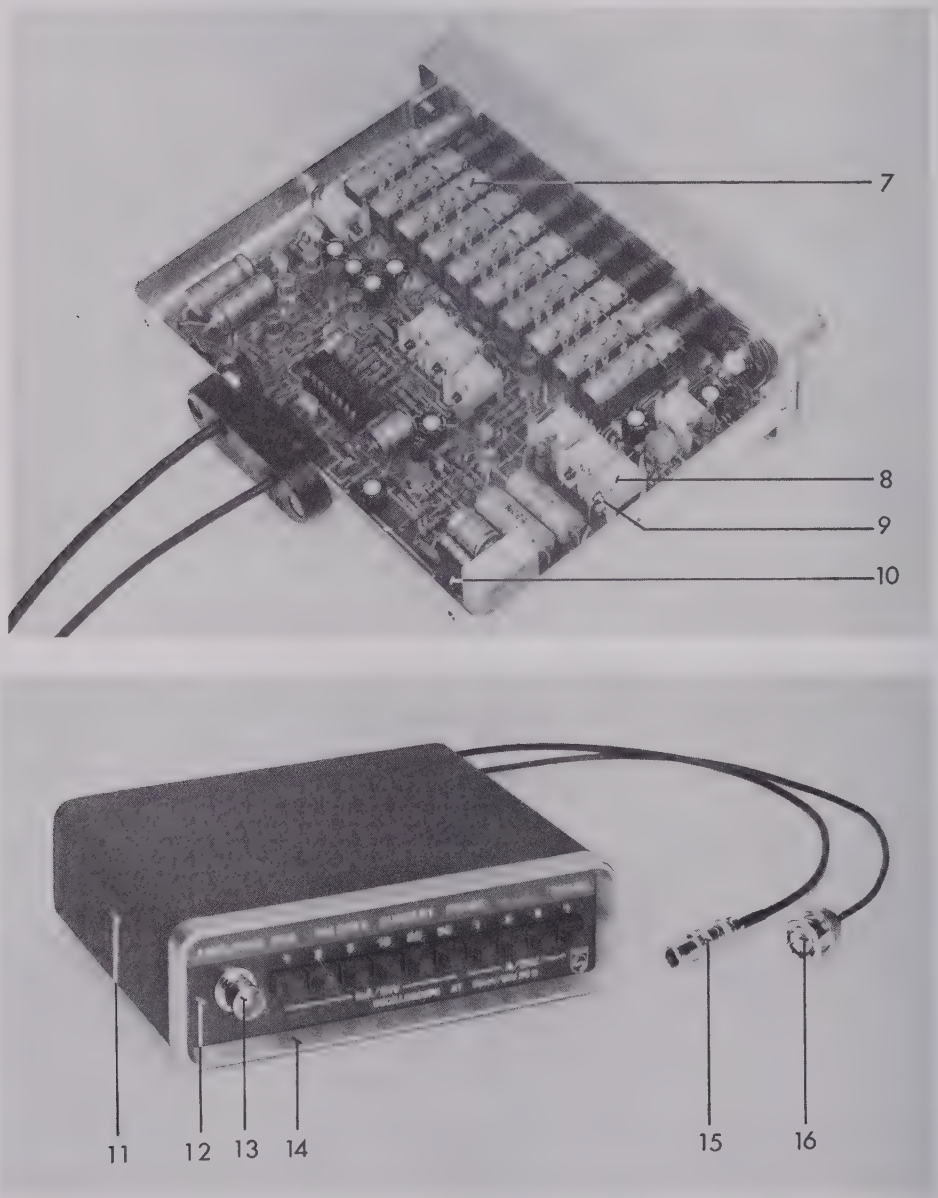


Fig. 4.6. Amplifier with item number indication

4.4.2. Electrical parts

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
CAPACITORS					
C1	5322 125 54031	25P			TRIMMER
C201	4822 122 31076	68P	2	100	CERAMIC PLATE
C202	4822 122 31056	12P	2	100	CERAMIC PLATE
C203	5322 124 14086	330M		6	ELECTROLYTIC
C204	5322 124 14086	330M		6	ELECTROLYTIC
C205	4822 122 30094	220P	10	100	CERAMIC PLATE
C206	4822 122 30103	22N	-20+100	40	CERAMIC PLATE
C207	4822 124 20454	150M		6,3	ELECTROLYTIC
C209	4822 122 30103	22N	-20+100	40	CERAMIC PLATE
C210	4822 122 31061	18P	2	100	CERAMIC PLATE
C211	5322 121 40197	1M	10	100	POLYESTER FOIL
C212	4822 122 30103	22N	-20+100	40	CERAMIC PLATE
C213	4822 124 20454	150M		6,3	ELECTROLYTIC
C214	4822 122 30103	22N	-20+100	40	CERAMIC PLATE
C215	5322 125 50051	18P		300	TRIMMER
C217	4822 122 30103	22N	-20+100	40	CERAMIC PLATE
C218	5322 125 50051	18P		300	TRIMMER
C219	5322 125 50051	18P		300	TRIMMER
C220	4822 122 30013	39P	2	100	CERAMIC PLATE
C221	4822 122 30103	22N	-20+100	40	CERAMIC PLATE
C222	4822 122 30103	22N	-20+100	40	CERAMIC PLATE
C223	4822 124 20459	22M		10	ELECTROLYTIC
C232	4822 122 30055	330P	10	100	CERAMIC PLATE
C233	4822 122 30055	330P	10	100	CERAMIC PLATE
C234	4822 122 30055	330P	10	100	CERAMIC PLATE
C236	4822 124 20587	100M		25	ELECTROLYTIC
C237	4822 122 30103	22N	-20+100	40	CERAMIC PLATE
C238	4822 122 30103	22N	-20+100	40	CERAMIC PLATE
C239	4822 124 20587	100M		25	ELECTROLYTIC
C241	4822 122 30103	22N	-20+100	40	CERAMIC PLATE
C242	4822 122 30103	22N	-20+100	40	CERAMIC PLATE

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
DIODES		
GR204	5322 130 30613	BAW62
GR206	5322 130 30759	BZX79/C5V6
GR207	5322 130 30667	BZX79/C9V1
GR208	5322 130 30667	BZX79/C9V1
INTEGRATED CIRCUITS		
IC201	5322 209 84386	TCA220
COILS		
L126	5322 158 14127	
L127	5322 158 14127	
L128	5322 158 14129	
L129	5322 158 14128	
L201	5322 158 10243	MICRO-CHOKE 100M

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
RESISTORS					
R1	5322 100 10143	1K	20	0,75	CARBON POTM
R2	5322 100 10143	1K	20	0,75	CARBON POTM
R126	4822 111 30245	47	5	CR16	CARBON
R127	4822 111 30245	47	5	CR16	CARBON
R200	5322 100 10133	220	20	0,75	CARBON POTM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R201	5322 116 54441	49,9	1	MR25	METAL FILM
R202	5322 116 50926	40,2	1	MR25	METAL FILM
R203	5322 111 44174	11	5	0,25	CARBON
R204	5322 116 50926	40,2	1	MR25	METAL FILM
R205	5322 111 44175	10	5	0,25	CARBON
R206	5322 116 50508	487	1	MR25	METAL FILM
R207	5322 116 54585	3,48K	1	MR25	METAL FILM
R208	5322 116 50593	16,2K	1	MR25	METAL FILM
R209	5322 116 50766	147	1	MR25	METAL FILM
R210	5322 100 10135	470	20	0,75	CARBON POTM
R211	5322 116 54442	51,1	1	MR25	METAL FILM
R212	5322 116 54617	9,53K	1	MR25	METAL FILM
R213	5322 116 54529	619	1	MR25	METAL FILM
R214	5322 116 50527	33,2	1	MR25	METAL FILM
R215	5322 116 50509	4,87K	1	MR25	METAL FILM
R216	5322 116 54585	3,48K	1	MR25	METAL FILM
R217	5322 116 54508	301	1	MR25	METAL FILM
R218	5322 116 50527	33,2	1	MR25	METAL FILM
R219	5322 116 54557	1,21K	1	MR25	METAL FILM
R220	5322 100 10143	1K	20	0,75	CARBON POTM
R221	5322 116 50767	2,15K	1	MR25	METAL FILM
R222	5322 116 50511	48,7	1	MR25	METAL FILM
R223	5322 116 54469	100	1	MR25	METAL FILM
R224	5322 116 54441	49,9	1	MR25	METAL FILM
R226	5322 116 54441	49,9	1	MR25	METAL FILM
R227	5322 116 54261	12,7	1	MR25	METAL FILM
R228	5322 116 54576	2,37K	1	MR25	METAL FILM
R229	5322 116 54576	2,37K	1	MR25	METAL FILM
R230	5322 116 54696	100K	1	MR25	METAL FILM
R231	5322 116 54632	14,7K	1	MR25	METAL FILM
R232	5322 116 50671	2,61K	1	MR25	METAL FILM
R233	5322 116 54619	10K	1	MR25	METAL FILM
R234	5322 116 54619	10K	1	MR25	METAL FILM
R235	5322 116 54469	100	1	MR25	METAL FILM
R237	5322 116 54005	3,32K	1	MR25	METAL FILM
R238	5322 116 50527	33,2	1	MR25	METAL FILM
R239	5322 116 54469	100	1	MR25	METAL FILM
R241	5322 116 54624	11,5K	1	MR25	METAL FILM
R240	5322 116 50767	2,15K	1	MR25	METAL FILM
R242	5322 116 54508	301	1	MR25	METAL FILM
R243	5322 116 54637	17,8K	1	MR25	METAL FILM
R244	5322 116 54617	9,53K	1	MR25	METAL FILM
R246	5322 100 10143	1K	20	0,75	CARBON POTM
R247	5322 100 10133	220	20	0,75	CARBON POTM
R248	5322 100 10133	220	20	0,75	CARBON POTM
R249	5322 100 10135	470	20	0,75	CARBON POTM
R251	5322 116 50527	33,2	1	MR25	METAL FILM
R252	5322 116 50484	4,64K	1	MR25	METAL FILM
R253	5322 116 50926	40,2	1	MR25	METAL FILM
R254	5322 116 54543	866	1	MR25	METAL FILM
R255	5322 116 50484	4,64K	1	MR25	METAL FILM
R256	5322 116 50527	33,2	1	MR25	METAL FILM
R257	5322 116 50579	3,16K	1	MR25	METAL FILM
R258	5322 116 54576	2,37K	1	MR25	METAL FILM
R259	5322 116 54576	2,37K	1	MR25	METAL FILM
R261	5322 116 54518	383	1	MR25	METAL FILM
R262	5322 116 54518	383	1	MR25	METAL FILM
R263	5322 116 54518	383	1	MR25	METAL FILM
R264	5322 116 50635	1,47K	1	MR25	METAL FILM
R266	5322 116 54686	75K	1	MR25	METAL FILM
R267	5322 116 50635	1,47K	1	MR25	METAL FILM
R268	5322 116 50459	422	1	MR25	METAL FILM
R260	5322 116 50459	422	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
TRANSISTORS		
TS201	5322 130 40326	BF173
TS202	5322 130 44396	BF324
TS203	5322 130 40493	BFY90
TS204	5322 130 40493	BFY90
TS205	4822 130 40964	BC549
TS206	5322 130 44396	BF324
TS207	5322 130 40373	BCY71
TS208	5322 130 40493	BFY90
TS209	5322 130 40373	BCY71
MISCELLANEOUS		
RE201-09	5322 281 64149	RELAY COIL 6V
RE201-09	5322 280 24036	RELAY CONTACT RI-20
U201	5322 216 94135	AMPIFIER P.C. BOARD

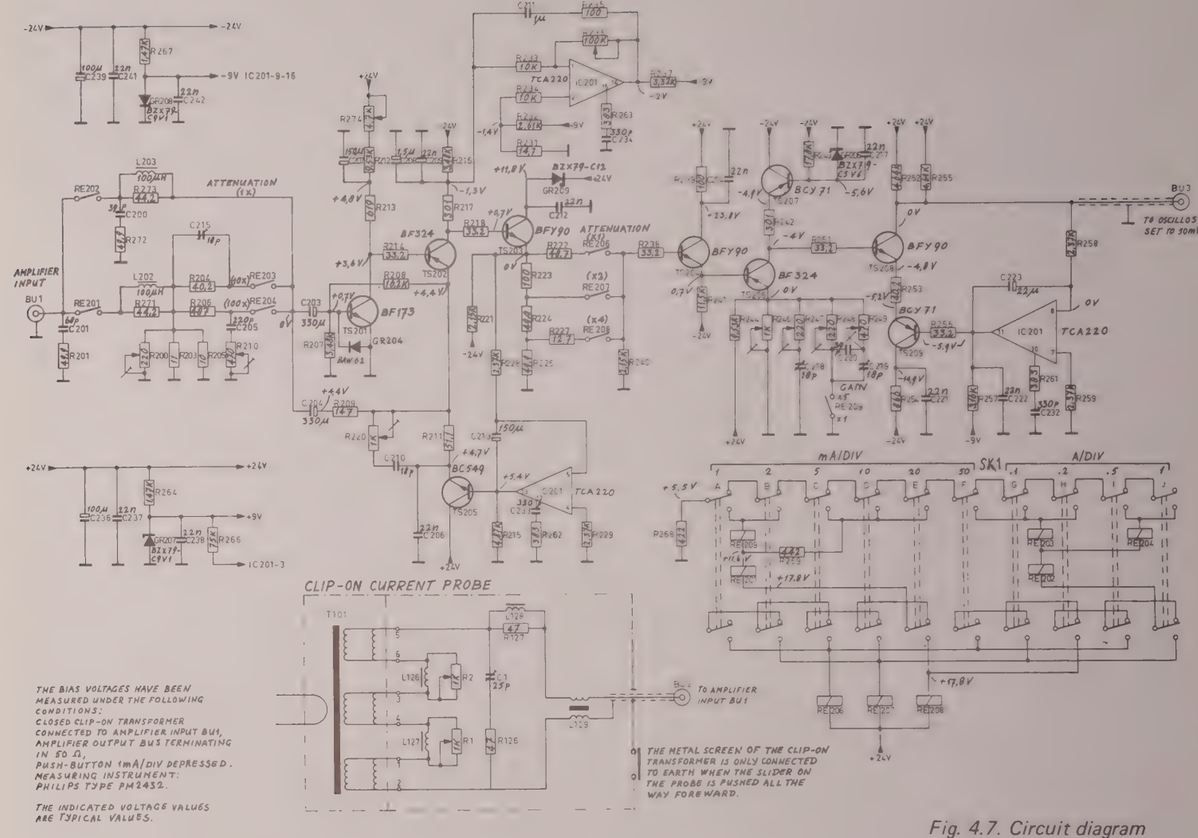

CLIP-ON CURRENT PROBE
THE BIAS VOLTAGES HAVE BEEN MEASURED UNDER THE FOLLOWING CONDITIONS: CLOSED CLIP-ON TRANSFORMER CONNECTED TO AMPLIFIER INPUT BU1, AMPLIFIER OUTPUT BU3 TERMINATING IN 50 Ω, PUSH-BUTTON 1mA/DIV DEPRESSED. MEASURING INSTRUMENT: PHILIPS TYPE PM2432.
THE INDICATED VOLTAGE VALUES ARE TYPICAL VALUES.
THE METAL SCREEN OF THE CLIP-ON TRANSFORMER IS ONLY CONNECTED TO EARTH WHEN THE SLIDER ON THE PROBE IS PUSHED ALL THE WAY FORWARD.
ATTENUATION
AMPLIFIER INPUT
TO OSCILLOSCOPE SET TO 30mV/DIV
mA/DIV
A/DIV
TCA220
BF324
BFY90
BCY71
BC549
BF173

Fig. 4.7. Circuit diagram

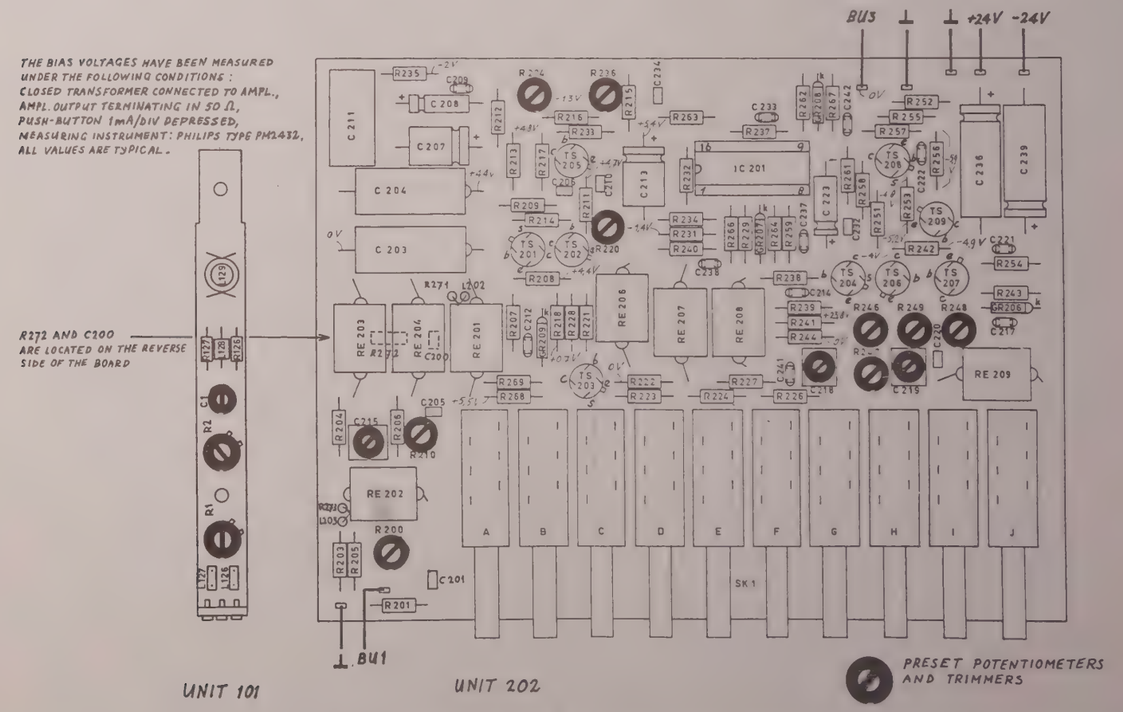

THE BIAS VOLTAGES HAVE BEEN MEASURED UNDER THE FOLLOWING CONDITIONS : CLOSED TRANSFORMER CONNECTED TO AMPL., AMPL. OUTPUT TERMINATING IN 50 Ω, PUSH-BUTTON 1mA/DIV DEPRESSED, MEASURING INSTRUMENT: PHILIPS TYPE PM2432, ALL VALUES ARE TYPICAL.
R272 AND C200 ARE LOCATED ON THE REVERSE SIDE OF THE BOARD
BU3
+24V
-24V
BU1
UNIT 101
UNIT 202
SK1
IC 201
PRESET POTENTIOMETERS AND TRIMMERS

Fig. 4.8. Printed-wiring boards of clip-on current transformer and amplifier with indication of adjusting elements

QUALITY REPORTING

CODING SYSTEM FOR FAILURE DESCRIPTION

The following information is meant for Philips service workshops only and serves as a guide for exact reporting of service repairs and maintenance routines on the workshop charts.
For full details reference is made to Information G1 (Introduction) and Information Cd 689 (Specific information for Test and Measuring Instruments).

LOCATION

□□□

Unit number
e.g. 000A or 0001 (for unit A or 1; **not 00UA or 00U1)**

or: Type number of an accessory (only if delivered with the equipment)
e.g. 9051 or 9532 (for PM 9051 or PM 9532)

or: Unknown/Not applicable
0000

COMPONENT/SEQUENCE NUMBER

□□□□□

Enter the identification **as used in the circuit diagram,** e.g.:

GR1003	Diode GR1003
TS0023	Transistor TS23
IC0101	Integrated circuit IC101
R0....	Resistor, potentiometer
C0....	Capacitor, variable capacitor
B0....	Tube, valve
LA....	Lamp
VL....	Fuse
SK....	Switch
BU....	Connector, socket, terminal
T0....	Transformer
L0....	Coil
X0....	Crystal
CB....	Circuit block
RE....	Relay
BA....	Battery
TR....	Chopper

CATEGORY

□

0 Unknown, not applicable (fault not present, intermittent or disappeared)
1 Software error
2 Readjustment
3 Electrical repair (wiring, solder joint, etc.)
4 Mechanical repair (polishing, filing, remachining, etc.)
5 Replacement
6 Cleaning and/or lubrication
7 Operator error
8 Missing items (on pre-sale test)
9 Environmental requirements are not met

Parts not identified in the circuit diagram:

990000	Unknown/Not applicable
990001	Cabinet or rack (text plate, emblem, grip, rail, graticule, etc.)
990002	Knob (incl. dial knob, cap, etc.)
990003	Probe (only if attached to instrument)
990004	Leads and associated plugs
990005	Holder (valve, transistor, fuse, board, etc.)
990006	Complete unit (p.w. board, h.t. unit, etc.)
990007	Accessory (only those without type number)
990008	Documentation (manual, supplement, etc.)
990009	Foreign object
990099	Miscellaneous

Sales and service all over the world

Alger: Sadetel; 41 Rue des Frères Mouloud Alger; tel. 656613–656607

Argentina: Philips Argentina S.A., Cassila Correo 3479, Buenos Aires; tel. T.E 70, 7741 al 7749

Australia: Philips Electrical Pty Ltd., Philips House, 69-79 Clarence Street, Box 2703 G.P.O., Sydney; tel. 2.0223

België/Belgique: M.B.L.E, Philips Bedrijfsapparatuur, 80 Rue des Deux Gares, Bruxelles; tel. 02/13.76 00

Bolivia: Industrias Bolivianas Philips S.A. LA Jón postal 2964 La Paz tel. 50029

Brasil: S.A. Philips Do Brasil; Avenida Paulista 2163; P.O. Box 8681; Sao Paulo S.P., tel 81-2161

Burundi: Philips S.A R L., Avenue de Grèce, B.P. 900, Bujumbura

Canada: Philips Electronic Industries Ltd., Scientific and Electronic Equipment Division, Philips House, 116 Vanderhoof Avenue, Toronto 17 M 4G 2JI. tel. (416)-425-5161

Chile: Philips Chiléna S.A., Casilla 2687, Santiago de Chile; tel. 94001

Colombia: Industrias Philips de Colombia S.A., Calle 13 no. 51-03, Apartado Nacional 1505, Bogota; tel. 473640

Costa Rica: Philips de Costa Rica Ltd., Apartado Postal 4325, San José; tel. 210111

Danmark: Philips Elektronik Systemer A/S Afd. Industri & Forskning; Strandlodsvej 4 2300-København S; Tel (0127) AS 2222; telex 27045

Deutschland (Bundesrepublik): Philips Elektronik Industrie GmbH, 2000 Hamburg 73, Meiendorferstraße 205; Postfach 730 370; tel. 6797-1

Ecuador: Philips Ecuador S.A., Casilla 343, Quito; tel. 239080

Egypt: Ph. Scientific Bureau 5 Sherif Str. Cairo – A.R. Egypt P.O. Box 1807; tel. 78457-57739

Eire: Philips Electrical (Ireland) Ltd., Newstead, Clonskeagh, Dublin 14; tel. 976611

El Salvador: Philips de El Salvador, Apartado Postal 865, San Salvador; tel. 217441

España: Philips Ibérica S.A.E., Avenida de America, Apartado 2065, Madrid 17; tel 2462200

Ethiopia: Philips Ethiopia (Priv. Ltd. Co.), P.O.B. 2565; Cunningham Street, Addis Abeba; tel. 48300

Finland: Oy Philips Ab, Postboks 10255, Helsinki 10; tel. 10915

France: Philips Industrie, Division de la S.A. Philips Industrielle et Commerciale 105 Rue de Paris, 93 002 Bobigny; tel. 830-11-11

Ghana: Philips (Ghana) Ltd., P.O.B. M 14, Accra; tel. 66019

Great Britain: Pye Unicam Ltd., York Street, Cambridge; tel. (0223) 58866

Guatemala: Philips de Guatemala S.A., Apartado Postal 238, Guatemala City; tel. 64857

Hellas: Philips S.A. Hellénique, 54, Ave Syngrou, Athens; tel 230476, P.O. Box 153

Honduras: Hasbun de Honduras Apartado Postal 83, Tegucigalpa; tel. 2-9121 ... 5

Hong kong: Philips Hong Kong Ltd., P.O.B. 2108, St. George's Building, 21st floor, Hong Kong; tel. 5-249246

India: Philips India Ltd., Shivsagar Estate, Block "A", Dr. Annie Besant Road, P.O.B. 6598, Worli, Bombay 18; tel. 370071

Indonesia: P. T. Philips Development Corporation, Jalan Proklamasi 33, P.O.B. 2287, Jakarta; tel. 51985-51986

Iran: Philips Iran Ltd., P.O.B. 1297, Teheran; tel. 662281

Iraq: Philips Iraq W.L.L. Munir Abbas Building 4th Floor; South Gate. P.O. box 5749 Baghdad; tel. 80409

Island: Heimilistaeki SF, Saetún 8, Reykjavik; tel. 24000

Islas Canarias: Philips Ibérica S.A.E., Triana 132, Las Palmas; Casilla 39-41, Santa Cruz de Tenerife

Italia: Philips S.p.A., Sezione PIT; Viale Elvezia 2, 20052 Monza; tel. (039) 361-441; telex 35290

Kenya: Philips (Kenya) Ltd., P.O.B. 30554, Nairobi; tel. 29981

Malaysia: Philips Malaya Sdn Bhd. P.O. Box 332, Kuala Lumpur;/Selangor W. Malaysia; tel. 774411

Mexico: Philips Comercial S.A. de C.V., Uruapan 7, Apdo 24-328, Mexico 7 D.F.; tel. 25-15-40

Nederland: Philips Nederland B.V., Boschdijk, Gebouw VB, Eindhoven; tel. 793333

Ned. Antillen: N.V. Philips Antillana, Postbus 523, Willemstad; tel. Curaçao 36222-35464

New Zealand: Philips Electronical Industries (N.Z.) Ltd., Professional and Industrial Division, 70-72 Kingsford Smith Street, P.O.B. 2097, Lyall Bay, Wellington; tel. 73-156

Nigeria: Philips (Nigeria) Ltd., 6 Ijora Causeway, P.O.B. 1921, Lagos; tel. 45414/7

Nippon: Nihon Philips Corporation, P.O.B. 13, World Trade Center, 32nd Floor, Tokyo 105; tel. (03) 435-5211

Norge: Norsk A.S. Philips, Postboks 5040, Oslo; tel. 463890

Österreich: Oesterreichische Philips Industrie GmbH, Abteilung Industrie Elektronik, Triesterstrasse 64, A-1101 Wien, tel. (0222) 645511/31

Pakistan: Philips Electrical Co. of Pakistan Ltd., El-Markaz, M.A. Jinnah Road, P.O.B. 7101, Karachi; tel. 70071

Paraguay: Philips del Paraguay S.A., Casilla de Correo 605, Asuncion, tel. 8045-5536-6666

Perú: Philips Peruana S.A., Apartado Postal 1841, Lima; tel. 326070

Philippines: Philips Industrial Development Inc., 2246 Pasong Tamo P.O.B. 911, Makati Rizal D-708; tel. 889453 to 889456

Portugal: Philips Portuguesa S.A.R.L., Av. Eng.° Duarte Pacheco, 6 – Lisboa – 1

Rwanda: Philips Rwanda S.A.R.L., B.P. 449, Kigali

Saoudi Arabia: A. Rajab and A. Silsilah P.O. box 203 Jeddah - Saudi Arabia; tel. 5113-5114

Schweiz-Suisse-Svizzera: Philips A.G., Binzstrasse 15, Postfach 8027, Zürich; tel. 051-442211

Singapore: Philips Singapore Private Ltd. P.O. Box 340; Toa Payoh Central Post Office; Singapore 12; tel. 538811

South Africa: South African Philips (Pty) Ltd., P.O.B. 7703, 2, Herb Street, New Doornfontein, Johannesburg; tel. 24-0531

Sverige: Svenska A.B. Philips, Fack, Lidingövagen 50, Stockholm 27: tel. 08/635000

Syria: Philips Moyen-Orient S.A. Rue Fardoss 79 Immeuble Kassas and Sadate B.P. 2442 Damas; tel. 18605-21650

Taiwan: Yung Kang Trading Co. Ltd., San Min Building, Gnd Floor, 57-1 Chung Shan N Road, 2 Section, P.O.B. 1467, Taipei; tel. 577281

Tanzania: Philips (Tanzania) Ltd., Box 20104, Dar es Salaam; tel. 29571

Thailand: Philips Thailand Ltd., 283, Silom Road, Bangkok; tel. 36980, 36984-9

Turkey: Türk Philips Ticaret A.S., Posta Kutusu 504, Beyoglu; Gümüssüyü Caddesl 78/80 Istanbul 1 Turkye

Uganda: Philips Uganda Ltd. p.o. Box 5300 Kampala; tel. 59039

Uruguay: Industrias Philips del Uruguay, Avda Uruguay 1287, Montevideo; tel 915641 Casilla de Correo 294

U.S.A.: Philips Test and Measuring Instruments Inc.; 400 Crossways Park Drive, Woodbury, N.Y. 11797; tel. (516) 921-8880

Venezuela: C.A. Philips Venezolana, Apartado Postal 1167, Caracas; tel. 360511

Zaire: Philips S.Z.R.L., B.P. 1798, Kinshasa; tel. 31887-31888-31693

Zambia: Philips Electrical Ltd., Professional Equipment Division, P.O.B. 553 Kitwe; tel. 2526/7/8; Lusaka P.O. Box 1878

750101

For information on change of address:
N.V. Philips
Test and Measuring Instruments Dept.
Eindhoven - The Netherlands

For countries not listed:
N.V. Philips PIT Export Dept.
Test and Measuring Instruments Dept.
Eindhoven - The Netherlands

NOTES:

PHILIPS

PHILIPS

SERVICE

Cryogenic Equipment / Electro Analytical Equipment / Electronic Weighing / Electron Optics / Industrial Data Processing systems / Numerical Control / Radiation Measuring Equipment / Test and Measuring Equipment / Welding Equipment / X-Ray Analysis

equipment for science and industry

780409 **TEST AND MEASURING EQUIPMENT** OSC21

PM 9355

Already published: -

Re : Modifications to version PM 9355/00 (Instruction manual 9499 440 14811)

PARTS LIST

Capacitors

Item	Ordering number	Value	tolerance (%)	Voltage (V)	Description
C126 added	4822 122 31054	10 pF	2	100	ceramic
C200 added	4822 122 31072	47 pF	2	100	ceramic
C201 changed to	4822 122 31058	15 pF	2	100	ceramic
C202 cancelled	-	-	-	-	-
C205 changed to	4822 122 30027	1 nF	10	100	ceramic
C206 changed to	4822 122 30043	10 nF	-20+100	40	electrolytic
C208 added	4822 124 20492	1,5µF	-	63	electrolytic
C216 added	4822 122 31054	10 pF	2	100	ceramic
C220 changed to	4822 122 31069	39 pF	2	100	ceramic
C226 added	4822 122 30103	22 nF	-20+100	40	ceramic
C233 changed to	4822 122 30103	22 nF	-20+100	40	ceramic
C243 added	4822 122 30103	22 nF	-20+100	40	ceramic

9499 448 09511

PRINTED IN THE NETHERLANDS

Resistors

Item		Ordering number	Value	tolerance	Description
R202	replaced by	5322 116 54595	R202+L204	(see coils)	
R212	changed to	5322 116 54595	5,11K	1	MR25
R219	changed to	5322 116 50675	2,26K	1	MR25
R230	cancelled				
R231	changed to	5322 116 50671	2,61K	1	MR25
R232	changed to	5322 116 54632	14,7 K	1	MR25
R236	added	5322 100 10142	100 K	20	wire wound pot.meter
R237	changed to	5322 116 50675	2,26K	1	MR25
R241	added	5322 116 54624	11,5 K	1	MR25
R244	changed to	5322 116 54595	5,11K	1	MR25
R270	added	5322 116 50592	442	1	MR 25
R271	added	5322 116 50818	44,2	1	MR25
R272	added	5322 116 50818	44,2	1	MR25
R273	added	5322 116 50818	44,2	1	MR25
R274	added	5322 100 10139	4,7 K	20	0,75W wire wound pot.meter

Diodes

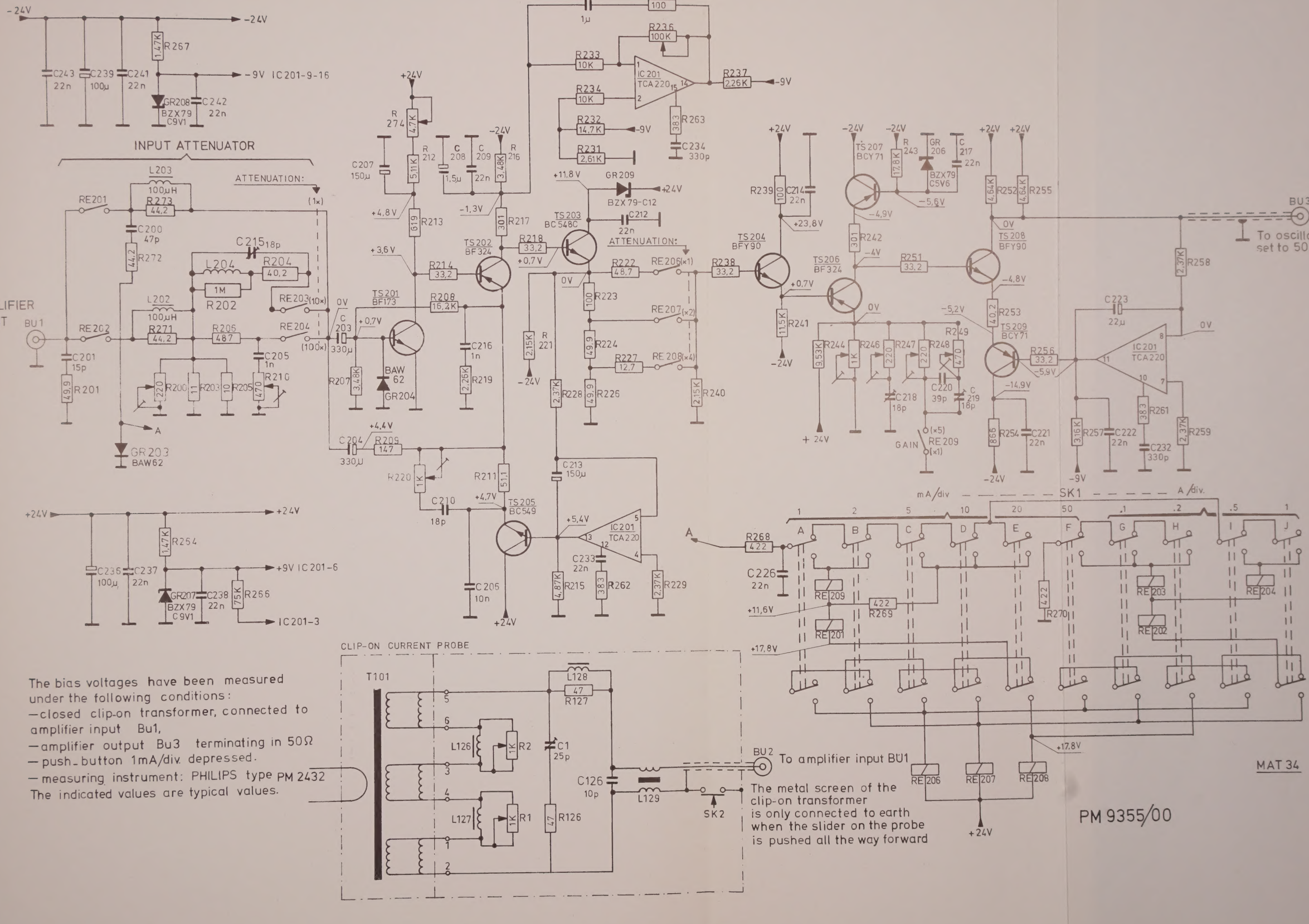
Item		Ordering number	type
GR203	added	4822 130 30613	BAW62
GR204	changed to	4822 130 30613	BAW62
GR206	changed to	5322 130 34173	BZX79-C5V6
GR207	changed to	4822 130 30862	BZX79-C9V1
GR208	changed to	4822 130 30862	BZX79-C9V1
GR209	added	4822 130 34197	BZX79-C12

Transistors

TS203	changed to	4822 130 44196	BC548C

Coils

L201	cancelled	-	-
L202	added	5322 158 10243	100µH micro choke
L203	added	5322 158 10243	100µH micro choke
L204	added	5322 157 14216	combination with R202 (1MΩ)


-24V
-24V
R267 1,47K
C243 22n
C239 100µ
C241 22n
-9V IC201-9-16
GR208 BZX79 C9V1
C242 22n
INPUT ATTENUATOR
ATTENUATION:
L203 100µH
R273 44,2
RE201
(1×)
C200 47p
R272 44,2
C215 18p
L204
R204 40,2
1M
R202
RE203 (10×)
AMPLIFIER INPUT
BU1
RE202
L202 100µH
R271 44,2
R205 487
RE204 (100×)
C201 15p
R201 49,9
R200 220
R203 11
R205 10
R210 470
C205 1n
A
GR203 BAW62
0V
C 203 330µ
+0,7V
TS201 BF173
R208 16,4K
BAW 62 GR204
R207 3,48K
C216 1n
R219 2,26K
+4,4V
C204 330µ
R209 147
R220 1K
R211 51,1
C210 18p
+4,7V
TS205 BC549
C206 10n
+24V
R 274 4,7K
R 212 5,11K
C207 150µ
+4,8V
R213 619
C 208 1,5µ
C 209 22n
-1,3V
R 216 3,48K
R217 301
+3,6V
R214 33,2
TS202 BF324
C211 1µ
R235 100
R236 100K
R233 10K
R234 10K
R232 14,7K
R231 2,61K
IC 201 TCA 220
R237 2,26K
-9V
R263 383
C234 330p
+11,8V
GR209 BZX79-C12
+24V
TS203 BC548C
C212 22n
R218 33,2
+0,7V
ATTENUATION:
R222 48,7
RE206 (×1)
R223 100
RE207 (×2)
R224 49,9
R227 12,7
RE208 (×4)
R221 2,15K
R228 2,37K
R226 49,9
R240 2,15K
C213 150µ
R225 1K
R227 4,87K
C233 22n
R215 4,87K
R262 383
R229 2,37K
+5,4V
IC201 TCA220
+24V
R239 100
C214 22n
+23,8V
TS204 BFY90
R238 33,2
11,5K R241
-24V
TS207 BCY71
R 243 17,8K
GR 206 BZX79 C5V6
C 217 22n
-4,9V
-5,6V
R242 301
-4V
TS206 BF324
0V
+0,7V
R251 33,2
TS208 BFY90
-4,8V
R252 4,64K
R255 4,64K
R253 40,2
TS209 BCY71
-5,2V
R249
R244 9,53K
R246 1K
R247 220
R248 220
R2 470
C218 18p
C220 39p
C 219 18p
R256 33,2
-5,9V
-14,9V
R254 866
C221 22n
+24V
GAIN
(×5)
RE 209
(×1)
-24V
-9V
C223 22µ
IC201 TCA220
R257 3,16K
C222 22n
R261 383
C232 330p
R259 2,37K
R258 2,37K
BU3
To oscilloscope set to 50 mV/div.
mA/div
SK1
A/div.
1 2 5 10 20 50 .1 .2 .5 1
A B C D E F G H I J
R268 422
C226 22n
+11,6V
RE209
RE201
422 R269
422 R270
RE203
RE202
+17,8V
RE206 RE207 RE208
+17,8V
+24V
+24V
R264 1,47K
C236 100µ
C237 22n
GR207 BZX79 C9V1
C238 22n
75K R266
+9V IC201-6
IC201-3
CLIP-ON CURRENT PROBE
T101
L128
47 R127
L126
1K R2
C1 25p
L127
1K R1
47 R126
C126 10p
L129
SK2
BU2
To amplifier input BU1
The metal screen of the clip-on transformer is only connected to earth when the slider on the probe is pushed all the way forward
The bias voltages have been measured under the following conditions:
—closed clip-on transformer, connected to amplifier input Bu1,
—amplifier output Bu3 terminating in 50Ω
—push-button 1mA/div. depressed.
—measuring instrument: PHILIPS type PM 2432
The indicated values are typical values.
MAT 34
PM 9355/00